

Electricity and Magnetism, Norway, JV (Justervesenet)

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		Expanded Uncertainty							
Quantity	Instrument or artifact	Instrument Type or Method	Minimum value	Maximum value	units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
DC voltage sources: single values	Solid state voltage standard	Direct comparison with standard	1	1	V			0.4	µV/V	2	95%	Yes			184
DC voltage sources: single values	Solid state voltage standard	Direct comparison with standard	1.018	1.018	V			0.4	µV/V	2	95%	Yes			185
DC voltage sources: single values	Solid state voltage standard	Direct comparison with standard	10	10	V			0.4	µV/V	2	95%	Yes			186
DC voltage sources: low values	Multifunction calibrator	Comparison with standard using a voltage divider	0.1	0.1	V			9	µV/V	2	95%	Yes			2
DC voltage sources: low values	Multifunction calibrator	Comparison with standard using a voltage divider	1	1	V			1	µV/V	2	95%	Yes			3
DC voltage sources: low values	Multifunction calibrator	Comparison with standard using a voltage divider	10	10	V			0.8	µV/V	2	95%	Yes			4
DC voltage sources: intermediate values	Multifunction calibrator	Comparison with standard using a voltage divider	1E+02	1E+02	V			1	µV/V	2	95%	Yes			5
DC voltage sources: intermediate values	Multifunction calibrator	Comparison with standard using a voltage divider	1E+03	1E+03	V			1	µV/V	2	95%	Yes			6
DC voltage sources: low values	Multifunction calibrator, voltage U	Comparison with standard using a voltage divider	0.1	10	V			(2 $U + 1$, U in V)	µV	2	95%	No	Non decadic values		235a
DC voltage sources: intermediate values	Multifunction calibrator, voltage U	Comparison with standard using a voltage divider	10	1E+03	V			2 U , U in V	µV	2	95%	No	Non decadic values		235
DC voltage meters: intermediate values	Multimeter	Direct comparison with calibrator	1E-02	1E-02	V			30	µV/V	2	95%	Yes			187

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DC voltage meters: intermediate values	Multimeter	Direct comparison with calibrator	0.1	0.1	V			5.5	µV/V	2	95%	Yes			188
DC voltage meters: intermediate values	Multimeter	Direct comparison with calibrator	1	1	V			1.5	µV/V	2	95%	Yes			189
DC voltage meters: intermediate values	Multimeter	Direct comparison with calibrator	10	10	V			1.5	µV/V	2	95%	Yes			190
DC voltage meters: intermediate values	Multimeter	Direct comparison with calibrator	1E+02	1E+02	V			3.6	µV/V	2	95%	Yes			191
DC voltage meters: intermediate values	Multimeter	Direct comparison with calibrator	1E+03	1E+03	V			4.0	µV/V	2	95%	Yes			192
DC voltage meters: intermediate values	Multimeter, voltage U	Direct comparison with calibrator	1E-02	10	V			(3 $U + 1$), U in V	µV	2	95%	No		Non decadic values	236
DC voltage meters: intermediate values	Multimeter, voltage U	Direct comparison with calibrator	10	1E+03	V			5 U , U in V	µV	2	95%	No		Non decadic values	237
DC resistance standards and sources: low values	Fixed resistor	Automatic DCC bridge	1E-03	1E-02	Ω	Power	10 mW	4	µΩ/Ω	2	95%	Yes			7
DC resistance standards and sources: low values	Fixed resistor	Automatic DCC bridge	1E-02	0.1	Ω	Power	10 mW	2	µΩ/Ω	2	95%	Yes			8
DC resistance standards and sources: low values	Fixed resistor	Automatic DCC bridge	0.1	1	Ω	Power	2 mW	0.7	µΩ/Ω	2	95%	Yes			9

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DC resistance standards and sources: intermediate values	Fixed resistor	Automatic DCC bridge	1	1E+04	Ω	Power	1 mW to 10 mW	0.5	μΩ/Ω	2	95%	Yes			10
DC resistance standards and sources: intermediate values	Fixed resistor	Automatic high resistance ratio bridge	1E+04	1E+05	Ω	Voltage	< 10 V	1	μΩ/Ω	2	95%	Yes			11
DC resistance standards and sources: intermediate values	Fixed resistor	Automatic high resistance ratio bridge	1E+05	1E+06	Ω	Voltage	< 10 V	3	μΩ/Ω	2	95%	Yes			12
DC resistance standards and sources: high values	Fixed resistor	Automatic high resistance ratio bridge	1E+06	1E+07	Ω	Voltage	< 10 V	5	μΩ/Ω	2	95%	Yes			13
DC resistance standards and sources: high values	Fixed resistor	Automatic high resistance ratio bridge	1E+07	1E+08	Ω	Voltage	< 10 V	12	μΩ/Ω	2	95%	Yes			14
DC resistance standards and sources: high values	Fixed resistor	Automatic high resistance ratio bridge	1E+08	1E+09	Ω	Voltage	< 10 V	20	μΩ/Ω	2	95%	Yes			15
DC resistance standards and sources: standards for high current	DC shunt	Automatic DCC bridge	1E-02	0.1	Ω	Current	0.2 A to 20 A	4	μΩ/Ω	2	95 %	Yes			16
DC resistance standards and sources: standards for high current	DC shunt	Automatic DCC bridge	1E-03	1E-02	Ω	Current	3 A to 100 A	4	μΩ/Ω	2	95 %	Yes			193
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Automatic DCC bridge / automatic High Resistance Ratio bridge	1	1.9	Ω	Power	1 mW to 10 mW	9	μΩ/Ω	2	95 %	Yes			194

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DC resistance standards and sources: multiple ranges	Multifunction calibrator	Automatic DCC bridge / automatic High Resistance Ratio bridge	10	19E+03	Ω	Power	1 mW to 10 mW	4	μΩ/Ω	2	95 %	Yes			195
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Automatic DCC bridge / automatic High Resistance Ratio bridge	1E+05	1.9E+05	Ω	Power	1 mW to 10 mW	7	μΩ/Ω	2	95 %	Yes			196
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Automatic DCC bridge / automatic High Resistance Ratio bridge	1E+06	1.9E+06	Ω	Power	1 mW to 10 mW	11	μΩ/Ω	2	95 %	Yes			197
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Automatic DCC bridge / automatic High Resistance Ratio bridge	1E+07	1E+07	Ω	Power	1 mW to 10 mW	12	μΩ/Ω	2	95 %	Yes			198
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Automatic DCC bridge / automatic High Resistance Ratio bridge	1.9E+07	1.9E+07	Ω	Power	1 mW to 10 mW	15	μΩ/Ω	2	95 %	Yes			199
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Automatic DCC bridge / automatic High Resistance Ratio bridge	1E+08	1E+08	Ω	Power	1 mW to 10 mW	24	μΩ/Ω	2	95 %	Yes			200
DC resistance meters: intermediate values	Multimeter	Applies standard resistors	10	1000	Ω	Resistance	10 Ω, 100 Ω, 1000 Ω	3	μΩ/Ω	2	95 %	Yes			201
DC resistance meters: intermediate values	Multimeter	Applies standard resistors	10E+03	10E+03	Ω			2	μΩ/Ω	2	95 %	Yes			204
DC resistance meters: intermediate values	Multimeter	Applies standard resistors	1E+05	1E+05	Ω			3	μΩ/Ω	2	95 %	Yes			205

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Quantity	Instrument or artifact	Instrument Type or Method	Minimum value	Maximum value	units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
DC resistance meters: intermediate values	Multimeter	Applies standard resistors	1E+06	1E+06	Ω			10	μΩ/Ω	2	95 %	Yes			206
DC resistance meters: intermediate values	Multimeter	Applies standard resistors	1E+07	1E+07	Ω			14	μΩ/Ω	2	95 %	Yes			207
DC resistance meters: intermediate values	Multimeter	Applies standard resistors	1E+08	1E+08	Ω			60	μΩ/Ω	2	95 %	Yes			208
DC resistance meters: intermediate values	Multimeter	Applies standard resistors	1E+09	1E+09	Ω			200	μΩ/Ω	2	95 %	Yes			209
DC current sources: low values	Multifunction calibrator	Voltage measurement across a shunt	1E-04	1E-04	A			9.0	μA/A	2	95%	Yes			210
DC current sources: intermediate values	Multifunction calibrator	Voltage measurement across a shunt	2E-04	2E-04	A			6.0	μA/A	2	95%	Yes			211
DC current sources: intermediate values	Multifunction calibrator	Voltage measurement across a shunt	1E-03	1E-03	A			9.0	μA/A	2	95%	Yes			212
DC current sources: intermediate values	Multifunction calibrator	Voltage measurement across a shunt	2E-03	2E-03	A			5.0	μA/A	2	95%	Yes			213
DC current sources: intermediate values	Multifunction calibrator	Voltage measurement across a shunt	1E-02	1E-02	A			8.0	μA/A	2	95%	Yes			214
DC current sources: intermediate values	Multifunction calibrator	Voltage measurement across a shunt	2E-02	2E-02	A			5.0	μA/A	2	95%	Yes			215
DC current sources: intermediate values	Multifunction calibrator	Voltage measurement across a shunt	0.1	0.1	A			8.0	μA/A	2	95%	Yes			216

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DC current sources: intermediate values	Multifunction calibrator	Voltage measurement across a shunt	0.2	0.2	A			5.0	µA/A	2	95%	Yes			217
DC current sources: intermediate values	Multifunction calibrator	Voltage measurement across a shunt	1	2	A	Current	1 A, 2 A	10	µA/A	2	95%	Yes			218
DC current sources: intermediate values	Multifunction calibrator	Voltage measurement across a shunt	10	10	A			20	µA/A	2	95%	Yes			220
DC current sources: intermediate values	Multifunction calibrator	Voltage measurement across a shunt	20	20	A			18	µA/A	2	95%	Yes			221
DC current meters: low values	Multimeter	Direct comparison with calibrator	1E-05	1E-05	A			40	µA/A	2	95%	Yes			222
DC current meters: low values	Multimeter	Direct comparison with calibrator	1E-04	1E-04	A			20	µA/A	2	95%	Yes			223
DC current meters: intermediate values	Multimeter	Direct comparison with calibrator	1E-03	0.1	A	Current	0.001 A, 0.01 A, 0.1 A	16	µA/A	2	95%	Yes			224
DC current meters: intermediate values	Multimeter	Direct comparison with calibrator	1	1	A			20	µA/A	2	95%	Yes			227
AC voltage: AC-DC transfer difference at medium voltages	Thermal converter, AC-DC transfer standard	Comparison	0.5	5	V	Frequency	10 Hz to 1 MHz	5 to 40	µV/V	2	95%	Yes	Um Voltage transfer standards		228
AC voltage: AC-DC transfer difference at higher voltages	Thermal converter, AC/DC transfer standard	Comparison	5	1E+03	V	Frequency	10 Hz to 1 MHz	10 to 80	µV/V	2	95%	Yes	Um Voltage transfer standards		229
AC voltage up to 1000 V: sources	Sources	AC/DC transfer standard, ACV-meter	1E-03	1E+03	V	Frequency	10 Hz to 1 MHz	30 to 8000	µV/V	2	95%	Yes	Um Calibrator (ACV)		230

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AC voltage up to 1000 V: meters	Meters	ACV calibrator	1E-02	700	V	Frequency	10 Hz to 1 MHz	50 to 10000	µV/V	2	95%	Yes	Um Multimeter (ACV)		231
AC current: AC-DC transfer difference	AC/DC current transfer standard	Comparison with reference standard	2E-03	20	A	Frequency	10 Hz to 10 kHz	30 to 250	µA/A	2	95%	Yes	Um Current transfer standards		232
AC current up to 100 A: sources	Multifunction calibrator	AC/DC transfer with thermal converters	1E-04	20	A	Frequency	10 Hz to 10 kHz	50 to 400	µA/A	2	95%	Yes	Um Calibrator (ACI)		233
AC current up to 100 A: meters	Meters	Comparison with ACI calibrator	1E-04	1	A	Frequency	20 Hz to 5 kHz	150 to 400	µA/A	2	95%	Yes	Um Multimeter (ACI)		234
AC power and energy: single phase ($f \leq 400$ Hz), active power	Wattmeter	Comparison with reference standard	7.5E-01	4.8E+04	W	Voltage	60 V to 480 V	100	µW/VA	2	95%	Yes			183
						Current	50 mA to 100 A								
						Power factor	1 to 0.25, inductive or capacitive								
						Frequency	50 Hz to 53 Hz								

Electricity and Magnetism, Norway, JV (Justervesenet)**Uncertainty table: Um Voltage transfer standards**

AC voltage: AC-DC transfer difference at medium voltages, JV Internal Identifier: 228

AC voltage: AC-DC transfer difference at higher voltages, JV Internal Identifier: 229

	10 Hz to 30 Hz	31 Hz to 300 Hz	301 Hz to 10 kHz	11 kHz to 50 kHz	51 kHz to 100 kHz	101 kHz to 200 kHz	201 kHz to 500 kHz	501 kHz to 700 kHz	701 kHz to 1 MHz
500 mV to 1 V	20	15	7	10	12	17	25	30	40
1.1 V to 3 V	15	10	5	7	10	15	20	25	35
3.1 V to 5 V	20	12	7	10	12	17	25	30	40
5.1 V to 10 V	25	20	10	12	15	20	30	35	45
10.1 V to 20 V	27	22	15	17	22	25	30	35	45
20.1 V to 30 V	30	25	20	25	27	30	35	40	50
30.1 V to 60 V	35	27	25	30	30	30	35	40	50
60.1 V to 100 V	37	30	30	35	40	-	-	-	-
100.1 V to 200 V	40	35	33	37	45	-	-	-	-
200.1 V to 300 V	45	37	35	40	50	-	-	-	-
300.1 V to 600 V	50	40	37	50	60	-	-	-	-
600.1 V to 1000 V	55	45	40	60	80	-	-	-	-

Voltage transfer standards

The expanded uncertainties given in this table are expressed in $\mu\text{V/V}$

Electricity and Magnetism, Norway, JV (Justervesenet)**Uncertainty table: Um Calibrator (ACV)**

AC voltage up to 1000 V: sources, JV Internal Identifier: 230

	10 Hz to 30 Hz	31 Hz to 300 Hz	301 Hz to 10 kHz	11 kHz to 50 kHz	51 kHz to 100 kHz	101 kHz to 200 kHz	201 kHz to 500 kHz	501 kHz to 700 kHz	701 kHz to 1 MHz
1 mV to 2 mV	2100	2000	2000	2200	2400	3000	3600	5500	8000
10 mV to 20 mV	310	300	300	400	500	700	900	1800	3100
100 mV to 200 mV	100	80	55	70	110	150	320	850	1500
500 mV to 3 V	90	70	40	45	50	70	100	200	700
1 V / 2 V	85	40	30	30	35	50	70	140	300
3.1 V to 20 V	100	80	75	75	80	95	110	250	600
10 V / 20 V	70	50	45	45	50	70	90	130	320
20.1 to 200 V	100	90	85	90	100	-	-	-	-
100 V / 200 V	75	60	55	65	70	-	-	-	-
200.1 V to 1000 V	120	105	90	200	300	-	-	-	-
700 V	85	70	65	110	150	-	-	-	-
1000 V	100	90	85	150	250	-	-	-	-

AC voltage calibrators

The expanded uncertainties given in this table are expressed in $\mu\text{V/V}$

Electricity and Magnetism, Norway, JV (Justervesenet)**Uncertainty table: Um Multimeter (ACV)**

AC voltage up to 1000 V: meters, JV Internal Identifier: 231

	10 Hz to 30 Hz	31 Hz to 300 Hz	301 Hz to 10 kHz	11 kHz to 50 kHz	51 kHz to 100 kHz	101 kHz to 500 kHz	501 kHz to 1 MHz
10 mV	-	600	470	1000	-	-	-
100 mV	190	160	130	220	-	-	-
1 V	70	52	50	90	150	5000	10000
10 V	64	52	50	90	150	5000	10000
100 V	80	55	55	120	170	-	-
700 V	-	120	120	330	-	-	-

AC voltage meters (multimeters)

The expanded uncertainties given in this table are expressed in $\mu\text{V/V}$

Electricity and Magnetism, Norway, JV (Justervesenet)**Uncertainty table: Um Current transfer standards**

AC current: AC-DC transfer difference, JV Internal Identifier: 232

	10 Hz	20 Hz	40 Hz to 1kHz	5 kHz	10 kHz
2 mA to 5 mA	50	40	40	40	40
5 mA to 20 mA	40	30	30	30	30
20 mA to 30 mA	50	40	40	40	40
30 mA to 300 mA	80	70	70	70	70
300 mA to 500 mA	120	110	110	110	110
0.5 A to 1 A	130	120	120	120	120
1 A to 2 A	160	140	140	140	140
2 A to 10 A	200	200	180	200	220
10 A to 20 A	220	220	200	220	250

Current transfer standards

The expanded uncertainties given in this table are expressed in $\mu\text{A}/\text{A}$

Electricity and Magnetism, Norway, JV (Justervesenet)**Uncertainty table: Um Calibrator (ACI)**

AC current up to 100 A: sources, JV Internal Identifier: 233

	10 Hz	20 Hz	40 Hz to 1 kHz	5 kHz	10 kHz
0.1 mA to 0.2 mA	150	120	100	200	400
1 mA to 2 mA	150	100	80	150	300
5 mA to 100 mA	60	60	50	60	70
100 mA to 300 mA	70	70	60	80	100
0.3 A to 1 A	110	110	100	110	150
1 A to 2 A	140	140	120	140	150
2 A to 10 A	200	200	180	200	220
10 A to 20 A	220	220	200	220	250

AC current calibrators

The expanded uncertainties given in this table are expressed in $\mu\text{A}/\text{A}$

Electricity and Magnetism, Norway, JV (Justervesenet)**Uncertainty table: Um Multimeter (ACI)**

AC current up to 100 A: meters, JV Internal Identifier: 234

	20 Hz	40 Hz to 1 kHz	1 kHz	5 kHz
0.1 mA	350	350	350	-
1 mA	300	250	250	350
10 mA	300	250	250	350
30 mA	-	-	150	-
60 mA	-	-	200	-
100 mA	300	250	250	350
119 mA	-	-	350	-
1 A	350	300	300	400

AC current meters (multimeters)

The expanded uncertainties given in this table are expressed in $\mu\text{A}/\text{A}$